

Independent Review of the University of North Carolina System Marine and Coastal Activities

A report prepared for
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Conducted by the American Association for the Advancement of Science (AAAS)
Research Competitiveness Program



Executive Summary

At the request of the University of North Carolina System General Administration (UNC-GA), the American Association for the Advancement of Science's (AAAS) Research Competitiveness Program undertook a comprehensive review of the marine and coastal programs within the UNC System. This report, based on that review, includes findings and recommendations that are meant to guide the UNC System as it seeks to leverage strengths and maximize impact of its marine-related program assets. In North Carolina, marine-related activities are important to the State's economy, both in traditional sectors like recreation and tourism, fisheries, hazard resilience, and marine heritage, and in emerging areas like wind energy and marine biotechnology. UNC System faculty members are leaders in areas such as marine biotechnology, wind energy, coastal sustainability, marine aquaculture, climate change and marine ecosystem health.

The review comes at a time of significant transition particularly for public institutions of higher education nationwide. This transition is driven to some degree by new technology that has enabled alternative modes and means of information delivery. But it is also driven by tight budget environments and heightened scrutiny aimed at ensuring effective use of resources. Assessing the capacities of programs, and in this case marine-related programs, that have a System-wide footprint, will help to remove barriers to cross-system programmatic synergies. This in turn will help to re-define the North Carolina experience for students.

Perhaps the most significant outcome of this review will be to better position the UNC system to compete in the changing academic landscape¹. The UNC System's marine-related programs have many forward-looking elements and best practices upon which to build. A system-wide effort to package and market the marine-related activities would enhance the external visibility and accessibility of these assets, which, when considered *in toto*, are formidable.

Comprising much of the breadth of marine and coastal sciences in the UNC System, a total of 26 units, referred to as "UNC Activities," were included as part of this review². These units constitute entities such as departments, centers, institutes, interdisciplinary degree programs, or other programs that the UNC viewed as relevant and significant to coastal and marine sciences in the State. At the start of this review, UNC-GA requested institutional self-studies which resulted in the capture of teaching, research and outreach services that were being conducted by UNC Activities in marine science. The content and depth of each of the self-studies varied, reflecting differences in mission, vision, resources, and capacity for marine science work at the institutions. In total, 8 self-study documents were generated (one from each of the six universities; these each had multiple Activities), the UNC Coastal Studies Institute, and the NC Sea Grant, which were then reviewed by a national panel of marine and coastal sciences experts convened by AAAS. The AAAS panel conducted a week-long site visit to interview faculty and administrators representing each of the UNC Activities and visited three cities along the coast, Wilmington, Morehead City, and Manteo, touring facilities at each

¹ "They never saw it coming." *Science* 339 (2013)

² This AAAS report includes a review of programs administered by the following institutions: East Carolina University (ECU), Elizabeth City State University (ECSU), North Carolina State University (NC State), University of North Carolina-Chapel Hill (UNC-CH), University of North Carolina – General Administration (UNC-GA), University of North Carolina at Wilmington (UNCW), and Western Carolina University (WCU).

location. In its deliberations, the panel considered the marine-related programs from a system-wide perspective using both the self-study documents and insights gathered from the site visits, presentations made by the units, and in-person interviews.

The AAAS panel soon determined that the UNC System has an extraordinarily rich assemblage of intellectual assets, facilities and capabilities that underlie research, education and outreach related to the coastal North Carolina marine environment, and more broadly to the regional, national and global environment. The word “assemblage” is used deliberately here because it appears that, historically, the planning and support of programs has been largely “siloeed” within institutions. The treatment of the programs in a more holistic and coordinated way, while still retaining institutional identity, presents a significant opportunity for North Carolina to amplify the collective impact and increase national recognition of its marine-related programs.

In North Carolina, the marine and coastal programmatic activities are hosted at institutions spanning the spectrum of institutional cultures, missions and Carnegie classifications³. Each UNC activity fills a unique niche, consistent with the institution’s culture and mission, to serve a distinct set of stakeholders. Most significantly, the AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs. Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

Grassroots collaborations do exist in several areas of the UNC System. However, these interactions tend to be between individuals or focused on specific project areas. What is lacking is a level of coordinated stewardship with full participation at the unit level that takes advantage of a comprehensive, “big-picture” view and can foster interactions among programs. With this level of coordination, the UNC Activities can function more strategically and work to more systematically develop opportunities that transcend individual programs, projects, and institutions. The benefit will be the System’s enhanced competitiveness in the marine-related programs, manifested in a coordinated brand that helps with recognition of system-wide assets, opportunities for enlarging and diversifying the research portfolio and new ways to control costs.

The AAAS panel offers 14 recommendations to improve coordination of UNC Activities that might then translate to better recognition of the strengths of the UNC marine-related activities both internally and externally. These recommendations are intended to be constructive and advisory. The mechanisms to effect changes administratively should be determined by UNC-GA. Four overlapping and complementary topic areas are identified to promote better leverage and efficiency across the UNC system: Statewide Planning and Coordination, Reducing Barriers for Research and Academic Collaborations, Marine Science Activities Planning and

³ The relative emphasis an institution of higher education places on research and undergraduate and graduate education defines its cultural landscape and is dictated by its mission. Insights into the cultural traditions at institutions of higher education can be gained from the Carnegie Foundation for the Advancement of Teaching’s classifications (<http://www.carnegiefoundation.org>), which attempt to categorize colleges and universities according to their highest or most dominant degree awarded (Associates, Bachelors, Masters, Doctoral) and the level of their research activity (Research Universities with average, high, and very high research productivity). In addition, to these generic labels, institutions have their own special cultural traditions.

Communication, and Other. Each of these recommendations is further detailed in Part I of the report.

Most of the recommendations below will not require great commitments of new fiscal resources, but they will require a common focus, clear leadership, more coordination and a commitment *by all of those involved*. The AAAS panel is convinced that if these recommendations are embraced, North Carolina will be in a leadership role nationally in marine-coastal research, education and service.

STATEWIDE PLANNING AND COORDINATION

RECOMMENDATION 1: The UNC GA should provide greater leadership and coordination of UNC System Activities. As a first step, UNC-GA should build on information in the self-studies as well as other sources to maintain and disseminate an up-to-date inventory of programs and activities. This effort should be complemented by the establishment of milestones and measurement and reporting of outcomes for all participating units.

RECOMMENDATION 2: The UNC System should commission studies on the economic valuation of coastal ecosystem services and natural capital as well as the direct and indirect economic benefits of marine science and technology activities. Such information should be used to communicate the economic value of North Carolina's coastal environment and the role of the UNC System in providing vital understanding, education and outreach to support the wise use and stewardship of natural resources as well as stimulating local, regional and statewide economies through marine science and technology investment.

RECOMMENDATION 3: The UNC System should foster the development of a clear brand or identity for the major marine-related assets and programs, building on the results of Recommendations 1 and 2. For example, with reasonable investment, marine science assets in the Morehead City-Beaufort area could easily be packaged as a national center of excellence. Also, one can imagine the "Marine Research Triangle Partnership" involving UNC-CH's IMS, NC State's CMAST and the Duke University Marine Lab (located in Beaufort), as a natural extension of the Research Triangle Park brand.

REDUCING BARRIERS FOR RESEARCH AND ACADEMIC COLLABORATIONS

RECOMMENDATION 4: The UNC System should foster stronger and more integrative research collaborations and focus more attention to communicating to the public the economic and societal benefit that such research is able to produce.

RECOMMENDATION 5: The UNC System should encourage efforts to remove barriers to academic collaboration.

RECOMMENDATION 6: The UNC System should encourage development of a coordinated online or hybrid course curriculum in marine science to leverage the breadth of activities offered throughout the State. These courses could be a component in a common, shared degree program in marine science (at the Master's or Ph.D. level), and would help maximize the use of teaching resources in the State without requiring duplication in hiring.

RECOMMENDATION 7: The UNC System and individual institutions should foster undergraduate research and encourage efforts to ensure that undergraduate and graduate student mentoring is sufficiently valued and rewarded.

RECOMMENDATION 8: The UNC System should consider building and maintenance of dormitories to foster residential academic programs at the three coastal locations (Wilmington, Morehead City, and Manteo) and to facilitate statewide participation in coastal field studies. More broadly, the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities (including equipment) in conjunction with overall capital improvement schedules.

MARINE SCIENCE ACTIVITIES PLANNING & COMMUNICATION

RECOMMENDATION 9: Leaders of UNC Activities should develop unit-level strategic plans that articulate explicitly with strategic planning by their home institutions and by the UNC System. These plans should include benchmarks and quantitative metrics and use the self-study reports as a starting point. Periodic assessments should be undertaken to monitor progress.

RECOMMENDATION 10: Leaders of UNC Activities should develop and execute a systematic and coordinated communication plan.

RECOMMENDATION 11: Leaders of UNC Activities should recognize and fully utilize the well-developed communication and outreach capabilities of North Carolina Sea Grant and the Coastal Studies Institute.

RECOMMENDATION 12: Leaders of UNC Activities should encourage the use of modern communication and social media technology to improve inter-unit communication and to enhance the curriculum at both the undergraduate and graduate levels.

OTHER

RECOMMENDATION 13: The UNC System should encourage all units to develop fund-raising strategies and plans in coordination with their home institutions, enhance external development programs and to engage external advisory committees and boards.

RECOMMENDATION 14: The UNC System should actively encourage and facilitate coordination of diversity initiatives for students and faculty in marine science.

Many excellent programs, centers and institutes can be found within the UNC System. With appropriate coordination, collaboration, communication, and support, these assets can achieve even more than they already do and provide the state with additional significant return on its investment.

The recommendations in this report are intended to support the UNC GA's ability to facilitate a culture of cross unit coordination and one that leads to a reduction in barriers to the mechanisms that would enhance it. Acting upon the recommendations of this report can result in improvements in both programmatic efficiencies and effectiveness. The panel suggests that

the UNC GA establish and determine the ground rules, but not manage the details. For example, significant program enhancement and efficiencies could be achieved if UNC Chapel Hill and NC State collaborate on operating a shared dormitory facility in Morehead City. The development of a joint master's or doctoral program, and shared coursework at any level, would expand opportunities for students without incurring significant additional personnel and operational costs. A shared system to manage vessels and equipment could both improve efficiencies and expand access of these resources to a wider user base. Shared approaches to public relations, development, and student recruitment could strengthen these activities while at the same time making more efficient use of personnel and operations budgets. The AAAS panel is convinced that if these recommendations are embraced and fulfilled at all levels, North Carolina can be in a leadership role nationally in marine-related research, education and service.

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Section I: AAAS Panel's Major Findings and Recommendations

Introduction and Context

The University of North Carolina (UNC) System has marine-related⁴ programs located throughout the State, from the western mountains to the coastal plain. To understand better the breadth and depth of these activities and to explore their possible synergies, the UNC General Administration (UNC-GA) commissioned the American Association for the Advancement of Science's (AAAS) Research Competitiveness Program to undertake a comprehensive review of the marine-related programs within the UNC System. The AAAS panel focused on developing recommendations that are meant to guide the UNC System as it seeks to leverage strengths and maximize the impact of its marine-related program assets. In total, 26 units, referred to as "UNC Activities," were included as part of this review, illustrating the breadth of marine and coastal sciences in the UNC System. These units constitute entities such as departments, centers, institutes, interdisciplinary degree programs, or other programs that the UNC viewed as relevant and significant to coastal and marine sciences in the State⁵.

The review comes at a time of significant transition particularly for public institutions of higher education nationwide. This transition is driven to some degree by new technology that has enabled alternative modes and means of information delivery. But it is also driven by tight budget environments and heightened scrutiny aimed at ensuring effective use of resources. Assessing the capacities of programs, and in this case marine-related programs, that have a System-wide footprint, will help to eliminate redundancies and remove barriers to cross-system programmatic synergies. This in turn will help to re-define the North Carolina experience for students. However, perhaps the most significant outcome of this review will be to better position the UNC system to compete in the changing academic landscape⁶. The UNC System's marine-related programs have many forward-looking elements and best practices upon which to build. A system-wide effort to package and market the marine-related activities would enhance the external visibility and accessibility of these assets, which, when considered *in toto*, are formidable.

The ocean is important whether you live on the coast or in the heartland. It covers 71% of the Earth's surface and contains 97% of the planet's water. The ocean drives our weather and climate through the global transfer of heat and water. The organisms in it generate much of the oxygen we breathe. And, nationally, more than 90,000 miles of shoreline support a \$60 billion recreation and tourism industry. In addition, the ocean supports a \$60 billion annual seafood industry and a \$20 billion recreational fishery and contains approximately \$8 trillion in oil and gas reserves as well as extensive capacity for offshore wind energy. Ninety five percent of the nation's commerce travels through U.S. ports⁷. In North Carolina, marine-related

⁴ The word "marine" is used throughout this report, but in reality, the AAAS panel is referring to a much broader purview that includes, coastal, estuarine, and related systems. It also covers diverse areas from the environmental sciences, to veterinary medicine, to social sciences and beyond. A comprehensive list of the activities in the review is provided in the Appendix.

⁵ This AAAS report includes a review of programs administered by the following institutions: East Carolina University (**ECU**), Elizabeth City State University (**ECSU**), North Carolina State University (**NC State**), University of North Carolina-Chapel Hill (**UNC-CH**), University of North Carolina – General Administration (**UNC-GA**), University of North Carolina at Wilmington (**UNCW**), and Western Carolina University (**WCU**).

⁶ "They never saw it coming." *Science* 339 (2013)

⁷ <http://www.oceanleadership.org/ocean-policy-legislation/ocean-leadership-policy-priorities/>

activities are important to the State's economy, both in traditional sectors like recreation and tourism, fisheries, hazard resilience, and marine heritage, and in emerging areas like wind energy and marine biotechnology. UNC System faculty members are leaders in areas such as marine biotechnology, wind energy, coastal sustainability, marine aquaculture, climate change and marine ecosystem health.

At the start of this review, the UNC-GA requested institutional self-studies which resulted in the capture of teaching, research and outreach services that were being conducted by 26 distinct UNC Activities in marine science. The content and depth of each of the self-studies varied, reflecting differences in mission, vision, resources, and capacity for marine-related work at the institutions. The self-studies were then reviewed by a national panel of marine and coastal sciences experts convened by AAAS. The members of the review panel are listed below (bios are included in the Appendix):

- Christopher F. D'Elia, Dean and Professor, School of the Coast and Environment, Louisiana State University
- Jacqueline Dixon, Dean and Professor, College of Marine Science, University of South Florida
- Steven E. Lohrenz, Dean and Professor, School for Marine Science and Technology University of Massachusetts-Dartmouth
- Nancy Targett, **(Chair)** Dean and Professor, College of Earth, Ocean, and Environment, University of Delaware

For this task, AAAS, together with the UNC-GA, developed a charge that focused on opportunities and leveraging across the UNC System (see Appendix). The AAAS panel conducted a preliminary assessment of each of the UNC Activity's capabilities and gaps, based on the questions from the AAAS charge. These preliminary findings laid out a foundation for the AAAS panel to conduct a week-long site visit to interview faculty and administrators representing each of the UNC Activities. The team visited three cities along the coast, Wilmington, Morehead City, and Manteo, touring on-site facilities at each location. In its deliberations, the panel considered the marine-related programs from a system-wide perspective using both the self-study documents and insights gathered from the site visits, presentations made by the units, and in-person interviews. At the end of the site visit, the AAAS panel briefed the UNC-GA VPR with its preliminary findings and recommendations. This report reflects a further discussion and refinement of those views.

This section of the report includes high-level findings and recommendations that emphasize opportunities for coordination across the UNC System (Question 3 of the AAAS Charge, see Appendix). Part II of this report includes further review of the UNC Activities, reflecting the panel's impression of how the units contribute to the totality of marine and coastal sciences in the State and where there are gaps (Questions 1 & 2 of the AAAS Charge).

North Carolina's Culture for Marine Science

In North Carolina, the marine and coastal programmatic activities are hosted at institutions spanning the spectrum of institutional cultures, missions and Carnegie classifications⁸. Each UNC activity fills a unique niche, consistent with the institution's culture and mission, to serve a distinct set of stakeholders. Marine programs at research-intensive universities such as UNC-CH and NC State contribute to our understanding of coastal hazards and resilience, marine ecosystem health, climate change, marine applications of food science and veterinary medicine. Benefits from these efforts accrue to the UNC System as a result of the national visibility of the work (publications in journals like *Science*, *Nature*, and *PNAS* for example; research dollars to the University) and the local impact of having nationally-acclaimed experts that are available to consult with State resource managers, legislators, or businesses. The research also translates into unique learning opportunities for students.

Marine and coastal programs at teaching-intensive institutions serve to educate the next generation of citizens to think broadly about environmental issues. UNCW, in particular, has embraced marine science as the signature theme for the entire university, and is explicitly reflected in traditional disciplinary areas (e.g., Departments of Physics & Physical Oceanography, Biology & Marine Biology, and Chemistry & Biochemistry). UNCW engages students, particularly at the undergraduate and master's level (and at the Ph.D. level in Marine Biology), in a significant experiential-learning process that builds on faculty research and innovative partnerships (e.g., Marine Biotechnology). Other teaching-intensive units also incorporate hands-on student experiences into their marine-related programs. ECU seeks to be an instrument of regional transformation and its marine-related emphases are in areas that are particularly important for the coastal state of North Carolina, including coastal science and policy, coastal resource management (including a Ph.D. program in this area), sustainable tourism and maritime heritage. At WCU the marine-related emphasis is concentrated in the study of developed shorelines. This program has national visibility and extramural funding in addition to strong undergraduate engagement in the analysis of data and production of data products such as the storm surge viewer or the beach nourishment viewer. ECSU's program, while small, collaborates successfully with other institutions both inside and outside of North Carolina to enhance opportunities for its students. As a historically-black college, ESCU offers the added dimension of serving under-represented groups and a pool of students interested in the field.

Marine-related programs like North Carolina Sea Grant and the UNC Coastal Studies Institute (CSI) fall outside of the Carnegie classification because they are not academic entities per se, but they serve a valuable role in translating science to the benefit of North Carolina stakeholders. NC Sea Grant and UNC CSI have a cross-state presence and perspective.

⁸ The relative emphasis an institution of higher education places on research and undergraduate and graduate education defines its cultural landscape and is dictated by its mission. Insights into the cultural traditions at institutions of higher education can be gained from the Carnegie Foundation for the Advancement of Teaching's classifications (<http://www.carnegiefoundation.org>), which attempt to categorize colleges and universities according to their highest or most dominant degree awarded (Associates, Bachelors, Masters, Doctoral) and the level of their research activity (Research Universities with average, high, and very high research productivity). In addition, to these generic labels, institutions have their own special cultural traditions.

It was apparent to the AAAS review panel that the marine-related programs within the state have self-selected into niches that largely complement each other rather than compete. More effective coordination of these already strong and diverse cross-state efforts could significantly strengthen them all and enhance the UNC System's competitiveness in this area; truly a "win-win-win" opportunity for the programs, the home institutions, and the system.

Strategic Thinking and Opportunities for the UNC System

Overview

The UNC System has an extraordinarily rich assemblage of intellectual assets, facilities and capabilities that underlie research, education and outreach related to the coastal North Carolina marine environment, and more broadly to the regional, national and global environment. The word “assemblage” is used deliberately here, because it appears that historically, the planning and support of programs has been largely “siloe” within institutions. The treatment of the programs in a more holistic and coordinated way, while still retaining institutional identity, presents a significant opportunity for North Carolina to amplify the collective impact and broaden recognition of its marine-related programs. Such a situation often exists in state university systems because they are large complex organizations composed of individual campuses with multiple and typically competitive leaders.

The coordination has already started organically in several areas of the UNC System. Grassroots collaborations do exist. Interactions do occur among the institutions, programs and laboratories at various levels including research and shared facilities (see Part II). However, these interactions tend to be between individuals or focused on specific project areas. What is lacking is a level of coordinated stewardship that has full participation at the unit level and also takes advantage of a comprehensive, “big-picture” view that can foster interactions among programs. This coordination need not be onerous, but it does require buy-in.

In undertaking this assessment, the UNC System has taken a critical step toward adapting to the changing academic landscape. Effecting change requires strong and committed leadership at all levels. The benefit will be the System’s enhanced competitiveness in the marine-related programs, manifested in a coordinated brand that helps with recognition of system-wide assets and opportunities for enlarging and diversifying the research portfolio. It should also help North Carolina’s competitiveness in vying for large federal center grants. This is really an opportunity for win-win solutions from which everyone can benefit.

The AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs (see section titled *The Degree to Which UNC Marine Activities Overlap*, p. 33). Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

This section of the report outlines steps to improve coordination of UNC activities that might then translate to better recognition of the strengths of the UNC marine-related activities both internally and externally.

In summary, four overlapping and complementary topic areas are identified to promote better leverage and efficiency across the UNC system: Statewide Planning and Coordination, Reducing Barriers for Research and Academic Collaborations, Marine Science Activities Planning and Communication, and Other. Each topic area is linked to a set of recommendations.

State-wide Planning and Coordination

• Building on Self Studies

RECOMMENDATION 1: UNC GA should provide greater leadership and coordination of UNC System Activities. As a first step, UNC-GA should build on information in the self-studies as well as other sources to maintain and disseminate an up-to-date inventory of programs and activities. This effort should be complemented by the establishment of milestones and measurement and reporting of outcomes for all participating units.

The self-studies are an important first step in understanding the breadth and depth of UNC System-wide assets. Next, the UNC System should develop a better understanding of the potential system-wide synergies by mapping the inventoried assets in a comprehensive way. This will highlight strengths and identify gaps and facilitate decisions to ensure that desired outcomes are being met and that programmatic impacts are being measured in a comprehensive way. With a better understanding of the breadth of the assets one can enhance system-wide competitiveness and impact.

• Economic Value of North Carolina's Coast

RECOMMENDATION 2: The UNC System should commission studies on the economic valuation of coastal ecosystem services and natural capital as well as the direct and indirect economic benefits of marine science and technology activities. Such information should be used to communicate the economic value of North Carolina's coastal environment and the role of North Carolina's system of higher education in providing vital understanding, education and outreach to support the wise use and stewardship of natural resources as well as stimulating local, regional and statewide economies through marine science and technology investment.

Programs within the UNC System provide vital understanding, education and outreach to support the wise use and stewardship of important coastal resources. Development of an economic valuation of the coast using traditional "neoclassical" market-based economics and also "biophysical" economics based on the valuation of ecosystem services and natural capital would put the UNC System in a much stronger position to demonstrate how its marine-related programs are of strategic importance to the people of North Carolina and beyond. Studies in other states have demonstrated that attracting a workforce with required skills is essential to commercialization and the development of new products derived from the marine sector⁹. Clear linkages to economic and educational impacts are essential to gain needed support in the business community and of other stakeholders. North Carolina Sea Grant is already doing a superb job translating science into economic benefit for the people of North Carolina and could be a significant resource in accomplishing this task (see below).

• Branding

RECOMMENDATION 3: The UNC System should foster the development of a clear brand or identity for the key marine-related programs, building on the results of Recommendations 1 and 2. For example, with reasonable investment, marine science assets in the Morehead City-Beaufort area could easily be packaged as a national center of excellence. Also, one can

⁹ Barrow, Clyde; Loveland, Rebecca; and Terkla, David, "Sailing into a Strong Future: The Massachusetts Marine Science and Technology Industry" (2005). MassBenchmarks. Vol. 7, No. 4, pp. 15-21: http://scholarworks.umb.edu/econ_faculty_pubs/24

imagine the “Marine Research Triangle Partnership” (MRTP) involving UNC-CH’s IMS, NC State’s CMAST and the Duke University Marine Lab (located in Beaufort), as a natural extension of the Research Triangle Park brand. The founding documents of the Research Triangle Park indicate that it is to be an engine for prosperity for the entire state, and MRTP could be a natural extension benefitting all.

The AAAS review panel was extremely impressed with the expertise and capabilities of North Carolina’s marine-related activities. Excellent facilities are available for them. However, when someone in the public thinks about ocean sciences, he or she inevitably identifies leading institutions such as Woods Hole, Scripps, and perhaps a few others. Few professionals, even those in the marine sciences, would identify Morehead City as a national center of excellence, except perhaps for the researchers located there. The UNC System has a wonderful prospect to develop a better identity for key marine resources. For example, Morehead City is truly an exceptional and important center of marine and coastal research at the national scale. The AAAS review panel visited the campuses of NC State’s Center for Marine Sciences and Technology (CMAST) and UNC’s Institute of Marine Sciences (IMS). Despite the close physical proximity of these two units and also Carteret Community College (CCC), and clear evidence that they cooperate in many ways, to the person driving down Arendell St. (US 70), they seem to be unrelated and distinctly independent entities. Why not try to give it a visual identity for what it really is: *a national powerhouse in marine science, research, education and outreach?* With some master planning and relatively little landscape architectural work and signage, a clear visual identity could be given to this significant campus as an integrated unit. This alone would make a powerful statement that would be very positively received by the local community in particular.

In addition, the coastal laboratory facility assets of the UNC System aggregate into three geographic clusters: Wilmington, Morehead City-Beaufort, and Manteo. The UNC System could create a virtual presence for its marine-related assets by aggregating and integrating them on a web site. The foundation for such a web portal appears to already exist in the form of a website focused on Coastal and Marine Sciences in North Carolina (<http://ncmarinescience.com/>). This portal could provide easy, comprehensive access to individuals trying to find a particular expertise, looking for specific projects, or trying to find course offerings in marine and coastal science.

Reducing Barriers for Research and Academic Collaborations

The AAAS review panel felt that the assemblage of UNC marine Activities, while encompassing impressive depth and breadth in marine-related research and education, lacked clear coordination and a statewide strategic vision for its marine and coastal endeavors. This apparent lack of coordination is an impediment to the ability of marine programs to advocate and communicate not only with higher levels within the administration of higher education and political leadership, but also to the general public.

• Research Collaborations

RECOMMENDATION 4: The UNC System should foster stronger and more integrative research collaborations and focus more attention to communicating to the public the economic and societal benefit that such research is able to produce.

The AAAS review panel heard about a number of ongoing research collaborations between the institutions and this is an area that should be encouraged to expand. The broad range of expertise across the UNC system presents an opportunity for developing highly competitive partnerships. Apparently, under President Bowles, the system office solicited responses previously for inter-campus collaborative research activities with the expectation of funding, but a lack of resources prevented this program from being realized. This unfortunately has resulted in skepticism about such efforts. The fact that the current external review was commissioned without an expectation of new resources is actually helpful. This should cause institutions to focus on stewardship of critical core capabilities instead of just worrying about jostling for new ones. Certainly system-wide collaboration could be framed around resources, the maintenance of current resource levels as well as attempts to secure new resources from the State of North Carolina or from other sources external to North Carolina.

Collaborative research efforts could also lead to increased efficiencies and support within the research enterprise for grant writing, patents and licensing, technology commercialization, and shared computational facilities.

• **Academic Collaborations**

RECOMMENDATION 5: The UNC System should encourage efforts to remove barriers to academic collaboration. For example, the UNC System could facilitate academic interaction by removing barriers that currently inhibit student and faculty exchange across institutions. Steps could include:

- selected course offerings across the system that might be targeted or designated as system-wide courses,
- common degree programs (Master's or Ph.D. level) with one or more degree-granting lead institution(s) but participation by other institutions (the Maryland MEES Program is an example).

All of these would help to facilitate articulation within the UNC System.

RECOMMENDATION 6: The UNC System should encourage development of a coordinated online or hybrid course curriculum in marine science to leverage the breadth of activities offered throughout the State. These courses could be a component in common, shared graduate degree programs in marine science, and would help maximize the use of teaching resources in the State without requiring duplication in hiring.

The AAAS review panel saw an opportunity for sharing the wealth of marine science expertise in the State through online courses and the use of technology in the curriculum. One opportunity would be to offer hybrid courses, with the bulk of the content offered online combined with a field component offered at the coastal marine stations.

- **Enhanced graduate and undergraduate experiential learning and field studies**

RECOMMENDATION 7: The UNC System and individual institutions should foster undergraduate research and encourage efforts to ensure that undergraduate and graduate student mentoring is sufficiently valued and rewarded.

For all the programs, it is clear that marine science activities provide enhanced hands-on learning and research experiences for undergraduates. The UNC System needs to assess the importance of experiential learning within the context of its strategic plan and then foster it as appropriate, encouraging recognition and compensation for faculty involved in it.

RECOMMENDATION 8: The UNC System should consider building and maintenance of dormitories to foster residential academic programs at the three coastal locations (Wilmington, Morehead City, and Manteo) and to facilitate statewide participation in coastal field studies. More broadly, the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities (including equipment) in conjunction with overall capital improvement schedules.

The coastal marine science activities offer unique facilities for focused research experiences (summer classes, semester-on-the-coast, etc.). Investment in dormitories at each coastal marine science region (UNCW-CMS in Wilmington, UNCCH IMS and NC State's CMAST in Morehead City, and UNC CSI in Manteo) has been suggested as a way to increase short course enrollments and provide living quarters for guest investigators. Institutions in the same region (e.g., CMAST and IMS in Morehead City) should be encouraged to coordinate or share dormitory facilities. And, while this does demand additional resources, it would significantly enhance these signature programs for North Carolina.

Marine Science Activities Planning and Communication

- **Strategic Planning**

RECOMMENDATION 9: Leaders of UNC Activities should develop unit-level strategic plans that articulate explicitly with strategic planning by their home institutions and by the UNC System. These plans should include benchmarks and quantitative metrics and use the self-study documents as a starting point. Periodic assessments should be undertaken to monitor progress.

All marine-related units should have strategic plans that clearly articulate their mission, vision, and values. Such plans should be developed with the involvement of external advisory boards, committees and councils. These plans should aggregate up to support the strategic plan of the units' home institution as well as the System's overall strategic plan. Outcomes should be directly related to these plans. Benchmarks and milestones, supported by quantitative metrics, will help to measure progress.

As a neutral broker, the System can facilitate the success of the unit strategic plans by encouraging inter-unit coordination and communication occur. Each unit should designate an individual charged with "administrative outreach" to other units, and identify an internal communication team with the responsibility to marshal resources and work with the System and other units. These efforts can complement and enhance existing assessment activities now

undertaken as part of the accreditation process required by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC).

- **Strengthening Internal and External Communication**

RECOMMENDATION 10: Leaders of UNC Activities should develop and execute a systematic and coordinated communication plan.

There is a need for these leaders to see that a system-wide synergy does not need to compromise a unit's fidelity to its home institution. Cultivating such system-wide synergies ensures future competitiveness and North Carolina is better prepared than many to meet that challenge. However, this will require a critical assessment of the current structures, sun-setting those that are not achieving meaningful outcomes and initiating new joint efforts that have bottom up and system buy-in (see additional discussion in Section II: The Degree to Which UNC Activities Coordinate). This may need to be facilitated by someone without institutional affiliation (for example, someone at the system level who is perceived as a neutral broker). The value of clear, coherent, and integrated picture of marine science in North Carolina to both internal and external audiences cannot be overstated (see section titled *The Degree to Which UNC Activities Coordinate*, p. 31).

To facilitate system-wide oversight, enhanced communication is essential at all levels: within institutions, among institutions and between individual institutions and the System Office. A coordinated communication plan needs to be developed and executed to achieve better internal and external recognition of marine related assets within the UNC System. Relevant parties should come together to determine a course of action to accomplish this in a way that does not interfere unnecessarily with unit autonomy or prevent a healthy level of measured inter-unit competition. Regular system-wide meetings to continue coordination and communication should be undertaken in the future. The AAAS review panel sensed that there was general, although not universal, willingness or even eagerness throughout the System to enhance communication and interaction, so now the time is right to do this.

Coordination of efforts related to public outreach could have system-wide benefits. Understandably, each institution has invested most of its efforts in its own public relations activities and must focus on its own priorities. Some programs were doing a commendable job in external communications, while others were less effective in that area. A signature brand that transcended institutions and drew people to a single portal to investigate the wide range of UNC System assets would clearly advantage all. The traditional modes of entry into UNC System assets would still operate but, the portal would provide the System-wide overview. The website <http://ncmarinescience.com/> provides a conceptual example for this type of portal. The adage that "a rising tide raises all boats" is applicable in that enhancing the visibility of marine programs, and developing a vision of a coordinated network of interrelated efforts would be a powerful message.

- **Utilization of North Carolina Sea Grant and the Coastal Studies Institute (CSI)**

RECOMMENDATION 11: Leaders of UNC Activities should recognize and fully utilize the well-developed communication and outreach capabilities of North Carolina Sea Grant and the Coastal Studies Institute.

Two units within the purview of the AAAS review seem to be underutilized for the capabilities they offer to the entire system. The first is North Carolina Sea Grant, which has a formal communications program and also has resources to bring faculty, students and staff together for workshops, meetings and large events. Sea Grant might be engaged to coordinate a biennial "all-hands" meeting. UNC CSI has remarkable facilities for video production and editing. In some ways, this new unit is searching for a broader identity beyond the obvious goal of serving a regional field-going facility need. Partnering with Sea Grant on communicating coastal issues and UNC System solutions may be one such mission element, and the visible and strong presence of Sea Grant at UNC CSI suggest that that might occur.

- **Communication Technology**

RECOMMENDATION 12: Leaders of UNC Activities should encourage the use of modern communication and social media technology to improve inter-unit communication and to enhance the curriculum at both the undergraduate and graduate levels.

More use could be made of currently available technological resources to foster meetings via interactive video, web hosted technology, Skype, etc. Social media are critical for communicating with younger audiences. A communication strategy should be developed for marine-related programs within the UNC System. Such efforts are especially critical given the geographic separation of facilities within and across institutions.

Other

- **Development**

RECOMMENDATION 13: The UNC System should encourage all units to develop fundraising strategies and plans in coordination with their home institutions' development office to enhance external development programs and to engage external advisory committees and boards.

Many public universities have begun the transition to a more private university budget model. Partnerships with local industries and organizations are critical. The AAAS panel recognized that most UNC Activities could enhance their external fundraising through gifts. Enhancement of the fundraising enterprise goes hand-in-hand with outreach to the local communities. The AAAS panel recognized the excellent job North Carolina Sea Grant was doing with respect to public outreach. Sea Grant can be an asset in development of community relationships that may translate into successful development efforts.

- **Diversity Initiatives**

RECOMMENDATION 14: The UNC System should facilitate coordination of diversity initiatives for students and faculty in marine science.

With better coordination, the marine science activity at Elizabeth City State University has the potential to provide a pool of underrepresented minority students to the research-intensive programs in the State. Other additional efforts to involve minority students should be undertaken.

A lack of diversity of faculty and students is also a challenge faced by the majority of the UNC marine programs as well as for geosciences across the country. As noted in a recent report by

the American Geophysical Union¹⁰, “the geosciences continue to lag far behind other sciences in recruiting and retaining diverse populations.” Many of the programs lacked any well-defined plans for enhancing the diversity of their students, staff and faculty. This is a glaring omission and should be clearly articulated in future strategic planning efforts.

¹⁰ Velasco and Velasco (2010) EOS Transactions of the American Geophysical Union Vol. 91. pages 289-296

Conclusions

The State of North Carolina is fortunate to have the intellectual capital of the UNC System to address its marine-coastal concerns and prospects. UNC System capabilities are formidable, both in terms of human resources and facilities. The UNC System has world-class institutions of higher education that participate in marine-related research from local and regional to global scales; strong State-based programs that excel in education and outreach; and non-academic programs that connect the institutions to stakeholders. In addition, the UNC System has the advantage of broad geographic presence throughout the State of North Carolina.

Many excellent programs, centers and institutes can be found within the UNC System. With appropriate coordination, collaboration, communication, and support, these assets can achieve even more than they already do and provide the state with additional significant return on its investment. The AAAS panel has offered fourteen recommendations that might be considered to help implement a more impactful and cohesive system-wide effort in the marine-coastal topic area. Most of these recommendations will not require great commitments of new fiscal resources, but they will require a common focus, clear leadership, more coordination and a commitment *by all of those involved*. The AAAS panel is convinced that if these recommendations are embraced and fulfilled at all levels, North Carolina will be in a leadership role nationally in marine-related research, education and service.

Section II:
An environmental scan of
University of North Carolina
Coastal and Marine Activities

Major Strengths or Unique Capabilities Supported by the UNC Activities

The AAAS panel expected to find significant strengths and capabilities supported by the campus activities throughout the UNC System, and it did. The following section offers highlights of unit strengths and their impacts.

The collective impacts of UNC coastal and marine activities extends from the transformative experiential student learning catalyzed by marine-related research at all institutions regardless of size and mission, to the research and faculty expertise that is a resource for national and state stakeholders (resource managers, business leaders, etc.), to specific positive economic outcomes, both fully realized (e.g., RecText, Surge Viewer, Surf Viewer, hybrid striped bass aquaculture), and potential (e.g., MARBIONIC, offshore wind energy, flounder aquaculture). Looking at the impacts and outcomes from marine-related activities as a whole, it is readily apparent that there is a strong case to be made for the importance of UNC-System research and education to the state and nation. A quantification of the economic value of North Carolina's coastal ocean to the State (e.g., fisheries, ecosystem services that enhance hazard resilience, tourism, etc.) would help to put the value of these efforts into context for the State.

Marine-related assets are found throughout the State of North Carolina. Along the coast there are three primary locations with ready access to the sea and where substantial laboratory and field research teams exist: Wilmington, Morehead City-Beaufort, and Manteo.

- **Wilmington.** UNCW labels itself North Carolina's Coastal University. In addition to the marine focus of the Center for Marine Science, coastal and marine themes are woven through the natural sciences, as well as through humanities, arts, and social sciences. It has a strong emphasis on experiential learning (primarily at the undergraduate and Master's level and also a Ph.D. in marine biology) that is facilitated by its proximity to dedicated research sites and to state-of-the-art laboratories and equipment. There is a rich cross-university curriculum that also includes inter-institutional partnerships such as the environmental science/environmental engineering 3+2 options with North Carolina State, articulation agreements with several North Carolina community colleges, international agreements with academic institutions, and internship opportunities with non-academic entities (e.g., state agencies, aquaria). Faculty members are dedicated and the leadership is forward looking. UNCW is looking to build capacity through additional innovative programming at levels that begin with K-12 (e.g., Marine Quest) and extend to partnerships between the MARBIONIC program and the Cameron School of Business (joint MBA postdoctoral fellowship) and to potential joint Ph.D. programs. Their focus is strategic with well-developed goals. The development of the Campus for Research Entrepreneurship, Service, and Teaching (CREST) is a potential game changer and has already resulted in significant uptick in grant support. UNCW has proposed the North Carolina Alliance in Marine Science (NC AiMS). In concept, this is the kind of collaborative partnership that would help to leverage the UNC-System's significant marine-related institutional assets in a coordinated and synergistic way.
- **Morehead City-Beaufort.** This area of the coast is home to the coastal lab facilities for UNC-CH and NC State and proximate to the Duke University Marine Laboratory. The central location along the coast provides convenient access to a large portion of state

waters and habitats. In addition, this area of the coast is home to several marine-related government labs.

- **UNC-CH Institute for Marine Sciences (IMS).** Located in Morehead City, IMS has 11 residential faculty (9 tenure track, 2 non-tenure track), who have stellar records of research (funding and publications) and service (federal, state, and local initiatives). The faculty members are engaged in research around questions that address three of the great societal challenges: the ability of people to live at the coast (hazards, sea-level rise), quality and safety of our water supply (ecosystem health and function, human health), marine resource development and sustainability (living and non-living resources, science-guided policy and protections). They are well-integrated into UNC-CH marine-related research activities, with most holding joint appointments in the Department of Marine Science on the main campus. In addition, the IMS-based faculty members have strong collaborations with other North Carolina institutions and marine-related activities. IMS faculty members actively participate in graduate education. Since IMS is not a degree granting entity, students matriculate through departments on the UNC-CH campus. IMS faculty are also active in other aspects of education, contributing to field, classroom, independent research, and capstone activities for UNC-CH students and more broadly for undergraduates from other institutions who participate in the NSF REU (Research Experience for Undergraduates) program in marine science that is based at IMS. The on-site seawater facilities are a significant plus and add to the breadth of research that can be conducted at the lab. These are shared with researchers at NC State-CMAST (located less than a mile away). IMS is also home to a state-of-the-art North Carolina Biotechnology Center-funded molecular training facility to train water quality professionals in molecular techniques. IMS has dormitories to serve visitors (faculty/students), although they need to be refurbished.
- **North Carolina State University (NC State)-Center for Marine Science and Technology (CMAST).** CMAST has a beautiful facility in relatively close proximity to Carteret Community College, North Carolina State Government Labs, and IMS. They have resident faculty from three colleges (Agriculture and Life Sciences, Physical and Mathematical Sciences, and Veterinary Medicine) spanning 6 departments as well as individuals from North Carolina Sea Grant and North Carolina Extension. The group is diverse and yet well-integrated with evidence of innovative partnerships on display throughout the building (the NCMSEP posters were particularly effective at presenting topical synergies). The leadership is forward looking with plans for growth that were well articulated and coincident with the NC State overall strategic goals. The focus at CMAST is on Ocean Health and Sustainability (One Health: healthy environment, healthy animals, healthy people). The presence of a marine animal veterinary science program and a food safety program make this site unique in the UNC System.

CMAST is coordinating NC State's plans to add several new faculty in coastal and marine sciences through the university's program in faculty excellence and to develop a semester-at-the-coast program that will further enhance student

engagement via hands-on learning. To support the latter, CMAST has developed plans to add a dormitory/guest house.

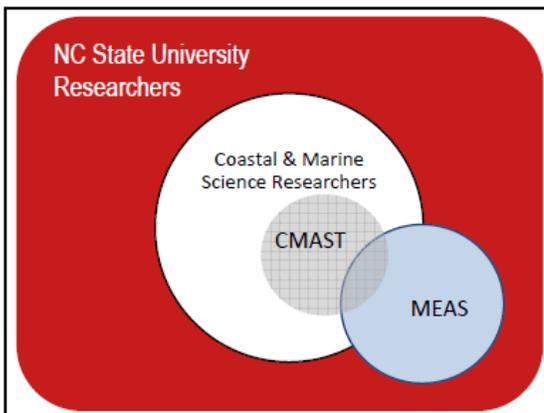
- **Manteo.** The UNC Coastal Studies Institute (UNC-CSI) is a multi-campus research, education and outreach partnership that provides institutional context and operational capability for collaborative research and programming in northeast North Carolina with marine-related activities housed throughout the State. It is located in a brand new building that includes state-of-the-art facilities. UNC-CSI can offer place-based, experiential learning and research opportunities in a unique coastal environment that are coordinated for inter-institutional programming that can augment traditional campus-based experiences. UNC-CSI is still undergoing some growing pains as it develops a business plan to sustain itself into the future.

In addition to the coastal sites, North Carolina is home to five institutions with marine-related activities and one, North Carolina Sea Grant that spans the State from the coasts to the Research Triangle.

- **East Carolina University (ECU).** The focus at East Carolina is largely regional in keeping with their goal of being a "*national model of regional transformation.*" The Institute for Coastal Science and Policy (ICSP) aggregates together faculty shared with the Departments of Anthropology, Biology, Economics, Engineering, Geography, Geological Sciences, Sociology, and Recreation and Leisure Studies to bring a multidisciplinary perspective (natural sciences and social sciences) to marine-related issues. Marine-related education at ECU is focused primarily on coastal resource management, sustainable tourism, natural hazards, and maritime heritage/archaeology. All of these programs have strong partnerships internal and external to ECU and there is good placement of students. There is also a Coastal-Maritime Council within ICSP that coordinates the 50+ ECU faculty members and administrators who have interests in coastal science and policy, and provides overall advice to the Institute.
- **Elizabeth City State University (ECSU).** ECSU is a Historically Black College and University (HBCU) and offers degrees at the baccalaureate and masters level to a diverse student body. This is the only HBCU in the State to offer an undergraduate marine science program and it could provide a pool of qualified under-represented students to the other State marine activities. Marine-related activities at ECSU have three components: 1. the marine environmental science program itself; 2. undergraduate research experiences in ocean, marine, and polar science; and, 3. the Center for Remote Sensing of Ice Sheets (CReSIS). Much of the responsibility for the program is shouldered by Dr. Maurice Crawford, who is carrying a 4/4 teaching load, supervising undergraduate research projects, writing proposals, and trying to carry out a limited research program. ECSU has been very effective at establishing partnerships with other institutions (examples include CReSIS and DREAMS-Diversity in Research and Environmental and Marine Sciences-activities). Interestingly, most of the partnerships are external to North Carolina leaving significant scope for growth within North Carolina.
- **NC State University (NC State).** NC State Vice Chancellor for Research, Innovation and Economic Development Dr. Terri Lomax provided an excellent representation of how the marine programs were positioned within NC State. There is an opportunity to use

this type of visualization at other institutions and to then aggregate them to give a clearer and more comprehensive picture of marine-related activities in the North Carolina System.

Marine-related activities at NC State occur on the coast at CMAST but also in the Department of Marine Earth and Atmospheric Sciences (36 faculty) as well as in other departments across the university that are broadly categorized as Coastal and Marine Researchers (faculty from 14 units crossing 7 colleges). MEAS has a program that is well integrated across the geosciences from earth to atmospheric systems. It has significant depth and breadth in the area of predictive computational modeling of marine systems, alone or coupled to other components of the Earth System. The non-MEAS marine related activities are significant. Notable assets include the NC State Center for Applied Aquatic Ecology (CAAE) under the direction of Dr. JoAnn Burkholder that provides water quality research information to policy makers and the Program for Sustainable Coastal Engineering (SCE) and Ocean Energy (OE) which is based in at UNC-CSI in Manteo.



The relationship of marine science researchers at NC State. (Figure provided by Dr. Terri Lomax, NC State Vice Chancellor for Research, Innovation, and Economic Development)

- **UNC-Chapel Hill (UNC-CH).** There are three marine-related units within UNC-CH: The Department of Marine and Atmospheric Science (MASC), Institute of Marine Science at the coast, and the Marine Sciences Program (MSP). All have faculty that function at a research-intensive level. The 13 tenure track and 3 research faculty in MASC are located in state-of-the-art space in the new UNC Science Complex (Venable Murray Hall). There is a strong and ongoing relationship with IMS faculty facilitated via video technology which links IMS with the main campus and via shared students and research. MASC clearly aligns with the primary elements of the UNC-CH strategic plan, touching on 4 of the 6. Marine-related faculty members at UNC-CH extend beyond MASC (including Departments of Biology, Geology, Environmental Sciences and Engineering, and Mathematics; the Institute for the Environment and the Renaissance Computing Institute). They have established collaborative relationships with each other and with other NC academic institutions. These include shared institutional appointments and cooperative academic programs (e.g., Ph.D. with UNCW). Shared state-of-the-art facilities at UNC-CH include the Joint Fluids Lab, the Aquarium Research Center, the Trace Metal Clean Room and the ICP-MS with laser ablation. In addition to partnerships

within and between North Carolina academic institutions, UNC-CH marine related faculty also partner with non-academic entities such as federal and State government agencies and the private sector. This enhances their impact.

- **Western Carolina University (WCU).** Marine science activity at WCU is focused on the Program for the Study of Developed Shorelines (PSDS) run by Dr. Rob Young and Dr. Andy Coburn. This strongly-branded, widely-recognized program, transferred from Duke to WCU in 2006. It is focused on coastal processes, particularly the science underlying coastal processes, and on how to develop and communicate science-based management recommendations to resource managers and to the public. The program is externally funded with excellent partnerships and produces data products widely sourced by the media and other public entities. The program leaders include undergraduates in their research programs and in the development of data product and publication outputs (e.g., sea level rise adaptation plans for the National Park Service and NOAA, coastal impact plans for dam removal in the Elwha River Dam, and maintenance of multiple large data bases for coastal processes such as the storm surge viewer and the beach nourishment viewer). PSDS program leaders are also engaged in significant service to federal, state, and local communities on issues related to coastal processes. At WCU, the PSDS has also expanded into areas beyond simply coastal processes, but related to its geological foundation. It is a tremendous resource for students at WCU and at Duke and it would be beneficial if it was promoted more conspicuously as an opportunity for students throughout the system.
- **North Carolina Sea Grant (NCSG).** NCSG is a federal, state, university partnership that engages North Carolina institutions through research, education, and extension projects to foster science-based decisions about the use and conservation of marine resources. Its administrative base is at NC State in Raleigh but it has staff located at UNCW, CMAST, and UNC-CSI, thereby functioning as a bridge that links many of the UNC System's marine-related activities. It facilitates inter-institutional engagement, acts as an "honest broker" to translate research to application, and has a rapid funding mechanism that can be used to address critical issues that arise. In addition, it supports a North Carolina Coastal Resources Law, Planning, and Policy Center on the NC State and UNC-CH campuses. NCSG is nationally recognized for its excellence, consistently ranking at or near the top of the 32 SG College Programs by NOAA Sea Grant National Office reviews. The program provides North Carolina with identifiable impacts and offering significant return on dollars invested. It has strong partnerships across North Carolina in academic and non-academic sectors.

Major Challenges Limiting the Impact of UNC Activities

The AAAS panel recognized that the UNC marine-related activities were facing challenges common to many other programs across the country, in addition to some that were unique to the specific circumstances of individual institutions. The changing face of higher education across the country as well as looming budget challenges are felt by all higher education institutions, and are particularly acute for marine-related programs that depend so heavily on external funding to support research and graduate education. Many state-funded universities are recognizing that they are morphing into state-located universities as their percentage of state funding drops. Public universities can either recognize the changing fiscal environment or face prolonged financial stress, deteriorating quality, and eventual decline (“death by a thousand cuts”). Adapting to the changing landscape requires strong leadership and strategy to replace state revenues with alternate sources of funding, as well as efforts to control costs in innovative and unprecedented ways.

The marine-related activities within the UNC system have tremendous potential to be able to not only weather this difficult period, but position themselves strategically to adapt and evolve to new ways of doing business and serving research, educational and societal missions. Perhaps one of the greatest obstacles to achieving this goal for the UNC marine programs is the lack of clear coordination and a statewide strategic vision for marine science. This has implications for the visibility and branding of marine science in North Carolina that is necessary for effective advocacy and communication within the UNC system, but also for communication with political and public sectors. The lack of leadership and coordination is also an impediment to effectively leveraging the depth and breadth of expertise and facilities across the UNC system to enhance capabilities to secure external funding and attract investment. In the remainder of this section, the AAAS panel considers challenges associated in the areas of people, equipment and facilities (as per the AAAS charge) as well as other areas identified by the panel.

People (teams, PIs, students, post docs). As noted under *Strengths* in the previous section, the researchers that the AAAS panel met were committed and dedicated. The various programs possess a broad range of individual talent, experience, and expertise and the faculty are true assets. Having said this, not all programs were “equal” in the sense that some programs such as WCU and ECSU have only a small number of faculty members in marine or environmental science programs serving a relatively large number of students. The UNC System may wish to examine whether strategic additions in faculty to these programs could yield benefits for broadening participation and enhancing diversity in marine science programs as well as Science, Technology, Engineering, Mathematics (STEM) education in general. Such programs may also have value as “feeder” schools for graduate programs elsewhere in the State. In addition to WCU and ECSU, UNCW also noted concerns about the number of faculty required to meet the teaching demands for their degree programs. Based on national trends, attrition due to faculty retirement is likely to be a challenge for all programs and something each program should consider in developing strategic plans for hiring new faculty at the institutional level as well as across the UNC system as a whole.

Finally, there were recurring themes in the self-studies about the challenges of recruiting and funding graduate students. Unlike some other professional programs, marine science programs traditionally provide support for their students, who are routinely expected to work on ongoing research projects. The ability to offer financial support is a major benefit to efforts to recruit

and retain high-caliber students. As funding becomes more constrained, so too will support for graduate students and institutions will have to expand and diversify the sources and strategies for funding students. This must necessarily involve efforts to secure funding for students through competitive educational grants, involvement of students in undergraduate teaching as teaching assistants, cooperative programs with private or public sector entities, and part-time students in employment situations that permit them to devote the necessary time to be successful in a degree program. Programs that explore alternative course delivery options (on-line, night and weekend course delivery, etc.) that are more accessible to the part-time or professional student should also be encouraged.

With regard to recruitment, the AAAS panel was provided with insufficient information to comment much about activities either at the institutional or system levels. Yet recruitment is a growing challenge as programs find themselves increasingly in competition not only with other marine programs, but with other fields as well. This is another example of how leadership at the UNC system level could benefit the entire UNC marine science effort through coordinated recruiting and branding of the marine science activities statewide.

Equipment. As was already noted, the nature of marine science research necessitates the use of expensive and highly-specialized equipment and analytical instruments. The various UNC coastal sites as well as their parent marine programs at the home institutions have an impressive inventory of state-of-the-art equipment and instruments. An emerging challenge faced by marine institutions in general is how to acquire and maintain such items and achieve an optimal level of use. The AAAS panel found very different strategies for dealing with expensive equipment used in marine-related research in the UNC system. On one end of the spectrum, UNCW openly shares its equipment with other users in the UNC System in return for reimbursement for supplies. Maintenance of the equipment is supported through return on indirect funds. Other institutions such as IMS operate their equipment as cost centers. Clearly, this is another area where inter-institutional coordination to facilitate shared use of expensive and highly-specialized equipment may be beneficial. Obviously, there are challenges to these types of arrangements, and different business models (e.g., UNCW or IMS) may be more or less appropriate to specific situations. However, UNC leadership might want to consider identifying centers of excellence for certain types of analytical capabilities that can serve multiple institutions where feasible. Strategies for coordinated asset development and usage will make UNC more competitive especially in an uncertain science funding climate. For example, as funding for start-up packages and major research instrumentation becomes more difficult to obtain, innovative thinking around partnerships will be necessary for universities across the nation.

Research Support Facilities. Facilities, especially research facilities, are expensive to operate and maintain and such costs are being scrutinized heavily as university budgets face rising costs and declining revenues. Additionally, while some facilities are relatively new and in excellent conditions (e.g., new buildings on UNCW campus, UNC CSI), other sites such as the IMS facilities are showing signs of age. Moreover, it was communicated to the AAAS panel that maintenance of the IMS facilities and possibly other sites are not part of system-wide or university capital improvement plans, leaving the burden of maintenance to fall on the individual laboratory. This is an unsustainable situation and the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities in conjunction with overall capital improvement schedules.

Two areas for which there was strong interest from UNC Activities were a functional coastal vessel and for dormitory space at coastal facilities. The retirement of the R/V *Cape Hatteras* was an external decision on the part of the National Science Foundation, which withdrew its support due to declining usage of vessels in the R/V Cape Hatteras class as well as considerations of its age and capability^{11 12}. This loss hampers the ability of UNC marine programs to provide both faculty and students readily available at-sea experience. An alternative that seemed to have considerable support was to acquire a smaller and more versatile moderate size catamaran vessel that could still maintain the needs of both research and educational activities. The AAAS panel encourages the UNC System to examine whether the operation of such a vessel could be financially sustainable given the multiple potential users within and outside the system of such a vessel within North Carolina as well as the external user community.

The need for dormitory space at coastal facilities was another area of common interest. Such facilities seem justifiable given the growing need to engage undergraduates in marine science as well as providing housing for graduate students, faculty and visitors conducting research at coastal sites. Summer experiences for undergraduates are perhaps one of the most effective ways to enhance the visibility of the marine programs across the State and garnish public awareness and support for these activities.

Other. The UNC system has various academic programs at the Bachelor's, Master's and Ph.D. levels. While a detailed assessment of each goes beyond the scope of the AAAS charge, it is recognized that academic programs are a critical aspect of the UNC marine programs. Despite their importance to the core mission of the various institutions, barriers to academic collaboration present a challenge for realization of the true potential for the UNC system to deliver a superior marine science curriculum. Various approaches to break down these barriers have already been suggested including system-wide courses, system-wide degree programs at the Master's or Ph.D. level, and distance learning and on-line delivery. Such activities may also help to overcome the challenges inherent in the geographic separation between the institutions as has been noted previously.

Even with these changes, an even greater challenge may be a reluctance on the part of some institutions to embrace such initiatives. The AAAS panel found that some individuals were reluctant to change the way their programs operate. In contrast, others were enthusiastic about this.

Another challenge seen by the AAAS panel was the lack of a system-wide communication strategy and clear branding for UNC marine science activities. For example, it was previously suggested that a branding of the UNC marine science activities as the "Marine Triangle

¹¹ Declining fiscal resources and increasing operational costs plague UNOLS (the University-National Oceanographic Laboratory System – www.unols.org) which operates our nation's research vessels. The loss of the vessel in North Carolina reflects an increasing challenge to maintain seagoing activities nationally. This situation is expected to get only worse in the future, as discretionary budgets get squeezed even further and as the cost of fuel continues to rise.

¹² "A Sea Change for U.S. Oceanography." *Science* 339 (2013)

Partnership” analogous to the Research Triangle in Raleigh/Durham might be advantageous. Communicating the unique qualities of each institution and the breadth and depth of facilities, infrastructure and expertise would be a powerful message.

The Degree to Which UNC Activities Coordinate

Substantive research collaborations already exist among institutions at the principal investigator level. Opportunities for coordination at the inter-institutional level have been discussed and include academic activities (system-wide courses, degree programs, on-line courses and distance learning) as well as messaging and public relations, and facilities and infrastructure.

The AAAS panel notes that attempts to develop coordinating councils in the past were apparently hampered by “turf” issues or lack of engagement. Over the years, a number of advisory boards, task forces and working groups have formed. In general, faculty impressions were that these entities had limited impact and some faculty expressed skepticism about these past efforts and their effectiveness. The North Carolina Alliance in Marine Science (NC AiMS) has been proposed by the Chancellor of UNCW to align marine programs in North Carolina, but whether other campuses buy-in to this is unclear.

The Marine Science and Education Partnership includes UNC-CH-IMS, NCState CMAST, Duke University Marine Laboratory, East Carolina University, NOAA, North Carolina Sea Grant and various community colleges, public school systems and other state and county agencies. This program appears to have merit, but excludes some programs and there was little information provided about it or its accomplishments.

One area of promising coordination was the relationship between the Marine Biotechnology in North Carolina (MARBIONC) and the Marine Bio-Technologies Center of Innovation (MBCOI) both at UNCW. These entities bring together researchers with private sector entities to support business incubator and economic development efforts around marine biotechnology initiatives. Another positive example of coordination was the Duke-UNC Oceanographic Consortium (DUNCOC), which was a multi-institutional consortium with the mission of operating the research vessel *Cape Hatteras*. The R/V *Cape Hatteras* has since been retired, and the fate of DUNCOC is uncertain. Thus, while some examples of coordination exist, the scope of these entities appears to be limited to specific thematic areas and none of them has a comprehensive mission.

Areas where coordination may be particularly advantageous include shared use of facilities. Some sharing of facilities is already occurring in specific situations, but much more can be achieved. Doing so, will not only achieve economies and leverage funding, but it will also increase impact. UNC Chapel Hill IMS houses space for North Carolina State CMAST in their seawater lab facility. A new coastal vessel would serve multiple users within the UNC system. This is especially important given the recent retirement of the R/V *Cape Hatteras*.

As was previously noted, the expansion of dormitory facilities that could house students from the main campuses at the coastal sites was a common theme across all the institutions. Summer programs at IMS and CMAST are constrained by dormitory space. In addition, educational programs at UNC CSI would also benefit from summer housing. This seems to be an obvious area where coordination and shared use of facilities would be beneficial.

While all institutions were engaged in outreach activities to some extent, some programs stood out. UNCW had various interactions with other institutions including student internships at state, federal and non-profit agencies. The Marine Quest program at UNCW is a receipt-

supported activity providing experiential learning opportunities for graduate, undergraduate and K-12 students. UNCW CMS was proactive in integrating marine science into various programs on the main campus. The summer programs at IMS, CMAST, and CSI could all be expanded. Another strong program was the Program for the Study of Developed Shorelines at WCU.

A major obstacle in coordination will be leadership. If any one institution appears to be taking the lead, other institutions may see this as a threat to their independence and stature related to marine science. Accordingly, leadership will be a challenge and a clear vision must be communicated as to what is the goal of this effort, what are the benefits, and how governance will be shared among the various institutions. Some agreement on how leadership for specific areas will be allocated among the institutions may be one approach for gaining acceptance of this concept. Limits to fiscal resources will always exist, and may even get worse. All entities must strive to work together to minimize costs and maximize benefits.

The Degree to Which UNC Marine Activities Overlap

The AAAS panel saw in each of the institutions a unique set of strengths and capabilities. Overlap in the expertise and research foci were minimal based on the self-studies and interviews with the UNC partners. While it could be argued that having three different coastal sites is duplicative, the case has been made that each of these coastal facilities is located in distinct geographic regions of the State and also serve different purposes. For example, the oyster research being done at UNCW and IMS involved differences in research priorities and each of these activities served a regional need to support the oyster fishery.

As already discussed, many of the marine institutions shared in the operation of the R/V *Cape Hatteras* prior to its retirement. Rather than overlap, this vessel provided a common platform that accommodated multiple and different uses specific to not only the UNC institutions, but to external users from across the country as well. All the marine programs would benefit from having a shared coastal vessel for example, and this would be consistent with the model used to operate the R/V *Cape Hatteras* by a consortium. Thus, such a model for vessel operation would increase efficiency and provide a more effective use of the vessel.

Dormitory facilities on the coast could also potentially be expanded and shared among institutions. This seems most logical in the case of CMAST and IMS, which are neighbors and both have need of student and faculty housing. These organizations already share seawater facilities so the shared operation of a dormitory is a logical extension.

The AAAS panel found that the academic programs exhibited unique strengths and curricular emphases. The panel still encourages the UNC System to examine the feasibility of a system-wide Ph.D. as other forms of academic collaboration and coordination. This would serve to ensure minimal overlap in the future as well as provide access to students to a wider range of options.

In summary, the AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs. Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

Appendix: UNC Activities Included in This Review

Universities and Activities

The following institutions and Activities submitted self-studies for inclusion in the AAAS review.

East Carolina University

- Institute for Coastal Science and Policy
- PhD Program in Coastal Resources Management
- Program in Maritime Studies
- Other Centers and Programs
 - PhD in Economics
 - RENCI@ECU
 - Center for Sustainable Tourism
- Departments with Significant Coastal Components
 - Geological Sciences
 - Biology
 - Geography
 - Other: COAS minor

Elizabeth City State University

- The Marine Environmental Science Program
- Undergraduate Research Experience in Ocean, Marine, and Polar Science
- Center for Remote Sensing of Ice Sheets

North Carolina State University

- Department of Marine, Earth, and Atmospheric Science
- Center for Marine Science and Technology
- Coastal and Marine Science Faculty

University of North Carolina at Chapel Hill

- Department of Marine Sciences
- Institute of Marine Sciences

University of North Carolina General Administration

- University of North Carolina Coastal Studies Institute*
- North Carolina Sea Grant College Program*
- Water Resource Research Institute*

University of North Carolina at Wilmington

- Center for Marine Science
- MARBIONC (Marine Biotechnology in North Carolina)
- Department of Biology and Marine Biology
- Department of Chemistry and Biochemistry
- Department of Environmental Studies
- Department of Geography and Geology
- Department of Physics and Physical Oceanography
- Department of Public and International Affairs
- Watson College of Education

Western Carolina University

- Program for the Study of Developed Shorelines

* Inter-institutional Institutes/Programs of the UNC System

Appendix: AAAS Panel Member Biographies

Review Panel Members

Dr. Christopher F. D'Elia earned his A.B. in Biology from Middlebury College, his Ph.D. in Zoology from the University of Georgia, and did postdoctoral work at UCLA and at the Woods Hole Oceanographic Institution. Prior to joining Louisiana State University in July 2009 as Professor and Dean of the School of the Coast and Environment, he was Associate Vice Chancellor for Academic Affairs for Research and Graduate Studies and Professor of Environmental Science & Policy and Marine Science at the University of South Florida St. Petersburg. There he also directed the International Ocean Institute-USA and the Center for Science and Policy Applications for the Coastal Environment and served from 2007- 2008 as Interim Vice Chancellor for Academic Affairs. He has also held professorships in Biological Science and Public Administration and Policy and was Vice President for Research & SUNY Research Foundation Operations Manager at the University at Albany, SUNY. From 1977-1999, he was a Professor at the Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science. He served as Director of the Maryland Sea Grant College Program of the University System of Maryland from 1989-1999. He has held appointments as the Ruth Patrick Distinguished Scholar in Aquatic Science at the Academy of Natural Sciences (Philadelphia), as the Director of the Biological Oceanography Program at the National Science Foundation in Washington, D.C. and as Provost and Vice President for Academic Affairs at the University of Maryland Biotechnology Institute. Dr. D'Elia has held numerous research grants and has authored or coauthored over sixty scientific publications on the nutrient dynamics of estuaries and coral reefs, and on science policy. He is a Fellow of the American Association for the Advancement of Science and has served on numerous advisory panels to the National Science Foundation and other federal, state and private funding agencies. He was elected to membership in the Cosmos Club, Washington, DC, in 1994. Dr. D'Elia is a former President of the Estuarine Research Federation and former Chair of the Board of Directors of the Council of Scientific Society Presidents. He has chaired the Mid-Atlantic Regional Marine Research Board and the Public Affairs Committees of the Ecological Society of America and of the American Society of Limnology and Oceanography. He has served twice as President, and as Co-Chair of the External Relations Committee, of the Sea Grant Association. He has been a member of the Scientific and Technical Advisory Committee to the Chesapeake Bay Program and has been Co-Chair of the Legislative Committee of the Commission on Food, Environment and Renewable Resources and Co-Chair of the Board on Oceans and Atmosphere of the National Association of State Universities and Land Grant Colleges (NASULGC), and a member of the Executive Committee of the NASULGC Council on Research Policy and Graduate Education. He has been a member of the Board of Directors of the Hudson River Foundation since 1998 and also served as Chairman of the Executive Board of the Science Center of Pinellas County until from 2007 - 2009. He is serving a second 3-year term as a member of the U.S. National Committee for the Intergovernmental Oceanographic Commission of UNESCO representing the Coastal and Estuarine Research Federation. He is also a board member and Chair of the Southeastern Universities Research Association's (SURA) Coastal and Environmental Research Committee, a member of the Board of Directors for the Baton Rouge Symphony Orchestra, a principal and former chair of the Gulf of Mexico University Research Collaborative and the Louisiana University Gulf Research Collaborative, and serves as Principal Investigator of the LSU component of the USDI South Central Climate Science Center.

Dr. Jacqueline Dixon is Dean of the College of Marine Science at the University of South Florida. She obtained her B.S. and M.S. degrees in geology from Stanford University in 1981 and 1983 and her Ph.D. in geochemistry from Caltech in 1992. Her academic career began as an Assistant Professor in Marine Geology and Geophysics at the University of Miami's Rosenstiel School of Marine and Atmospheric Science in 1992. She is an internationally recognized leader in her field of igneous geochemistry with 36 published articles in top-ranked journals, including *Nature*. Her research specialties are mantle geochemistry and submarine volcanism. Specifically, her research focuses on the role of volatiles, mainly H₂O and CO₂, in the generation and evolution of mantle melts. She received an Early Career award in 1997 for excellence in research and education. In 2007, a premier journal in her field (EPSL)

acknowledged one of her papers as one of their top-50 most cited articles. Prior to her arrival at the University of South Florida in 2011, she served one year as Interim Dean of the College of Arts and Sciences at the University of Miami, three years as Senior Associate Dean for the Life and Physical Sciences in the College of Arts and Sciences, and five years as Director of the undergraduate program in Ecosystem Science and Policy. She was recently elected as a Trustee of the Consortium for Ocean Leadership. She is a member of the American Geophysical Union, the Geochemical Society, the International Association of Volcanology and the Earth's Interior, and the American Association for the Advancement of Science.

Dr. Steven E. Lohrenz is Dean and Professor of the School for Marine Science and Technology (SMAST) at the University of Massachusetts Dartmouth. Prior to becoming Dean of SMAST, Steve served as Chair of The University of Southern Mississippi (USM) Department of Marine Science, located at the NASA John C. Stennis Space Center. He received a B.A. in biology and chemistry from the University of Oregon (1978) and a Ph.D. in biological oceanography (1985) from the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program, and was a National Research Council post-doctoral fellow at the Naval Ocean Research and Development Activity (now part of the Naval Research Laboratory). His research extends across various themes of biological oceanography including phytoplankton physiology, community structure, ecology, primary production, biogeochemical cycling, and terrestrial-ocean interactions. His current work also includes applications of optics and remote sensing in the study of biological and biogeochemical patterns and processes in aquatic environments. He has authored or co-authored more than 60 papers in refereed literature and participated in more than 50 research cruises. He is a Contributing Editor for Marine Ecology Progress Series. He currently serves on the Board of Directors of the Northeast Regional Association Coastal Ocean Observing System and is Councillor-at-large of the Oceanography Society. He is a Trustee for the Consortium for Ocean Leadership, and is chair of the Consortium's Ocean Observing Subcommittee. He was formerly co-chair of the Board on Oceans and Atmosphere of the National Association of State Universities and Land Grant Colleges (now the Association of Public and Land Grant Universities). He has served on numerous other advisory groups including the Carbon Cycle Science Working Group (2009-2011) and the Ocean Carbon and Biogeochemistry Steering Committee (2006-2011), and the NASA Geostationary Coastal and Air Pollution Events (GEO-CAPE) Satellite Mission Science Working Group (2011-present). He is a member of the American Geophysical Union, the American Society of Limnology and Oceanography, the American Association for the Advancement of Science, the Optical Society of America, and the Oceanography Society.

Dr. Nancy Targett (Chair) is Dean of the College of Earth, Ocean, and Environment (CEOE) at the University of Delaware and Director of the Delaware Sea Grant College Program. During her tenure as Dean she has broadened the focus of her college to include Geological Sciences, Geography, Environmental Science and Environmental Studies in addition to the Marine Science and Policy Programs that were always the core of the college. The college turned 40 in June 2010 and what began as the Graduate College of Marine Studies, now, 40 years later, has both an undergraduate and graduate presence and is well-integrated into the fabric of the University. In 2008 she chaired a task force that developed a curriculum that would ensure that students received a truly multidisciplinary exposure to the issues in environmental science, while still getting the depth of disciplinary content necessary to be successful. The result was a cross-college multidisciplinary program established in September 2009 that is training tomorrow's environmentally-focused leaders. To model environmental sustainability and provide a platform for research efforts aimed at catalyzing the offshore wind sector, she built a utility-scale (2 MW) wind turbine at the Lewes campus. The turbine provides enough green energy to cover all of the campus' electrical needs. CEOE has a world-wide footprint with research programs that extend across the globe from the upper atmosphere to the land to the bottom of the ocean. Four years ago, Nancy initiated collaboration with Xiamen University and their College of Marine and Environmental Science. That effort now includes a dual Ph.D. degree program in Oceanography and has catalyzed interactions with XMU beyond CEOE such as the recently established Confucius Institute located at UD.

Nancy just completed her term (2010-2013) as chair of the Board of Trustees for the Washington D.C.-based Consortium for Ocean Leadership, a 96 member group of academic institutions, industry and NGOs with a focus on ocean issues. She is also an Aldo Leopold Leadership Fellow. A past officer of the International Society of Chemical Ecology, she has served on numerous editorial boards and been appointed to various national and regional scientific councils and committees. She has served on the National Academy's Ocean Studies Board and chaired or been a member of several of its study committees. She has also served on the Mid-Atlantic Fisheries Management Council and chaired the science and statistics committee and several species committees. Nancy is a past officer of the Sea Grant Association and currently serves as its treasurer. She lives in Sussex County. There she was a founding board member of the Jefferson School, an independent day school located in Georgetown, Delaware, and of the Sussex Academy of Arts and Sciences, a charter middle school also located in Georgetown, Delaware. She served terms as chair for both boards. She also served as a member of the board of St. Thomas More Academy High School in Magnolia. Currently she is a member of the boards for the Greater Lewes Foundation and for Cadbury Continuing Care.

AAAS Staff

Dr. Rieko Yajima is a Project Director with the AAAS Research Competitiveness Program (RCP), where she has led over 35 projects providing clients with technical assistance for improved research, development, and innovation strategies. Her expertise is in evaluating the outcomes and impacts of scientific research, as well as planning and implementing programs for strengthening research capacity and competitiveness. She recently led a comprehensive evaluation of the Marine Microbiology Initiative: a 10-year, \$145-million effort to answer fundamental questions about the immense diversity of marine microorganisms and their roles in ocean health, funded by the Gordon and Betty Moore Foundation in Palo Alto. Rieko has organized symposia on emerging interdisciplinary topics for the AAAS annual meeting on research collaborations between artists and scientists, as well as the science behind delicious food. Trained as a biochemist, Rieko received awards for her Ph.D. research on RNA enzymes and has published over 10 research and review articles on the molecular structure and function of protein and RNA enzymes. Prior to AAAS, she was also a Science Policy Fellow at the National Academy of Sciences in Washington, D.C..

Appendix: Charge to the AAAS Review Panel

Charge for the AAAS Review of the University of North Carolina Coastal and Marine Science Activities (FINAL)

1. Understand the impacts of UNC coastal and marine science Activities.
 - a. What are the most significant impacts in the following areas?
 - i. Teaching and Instruction
 - ii. Public Service, Outreach and Community Engagement
 - iii. Professional Service
 - iv. Research
 - v. Economic Development
 - b. How does the quality of the Activities compare to similar Activities elsewhere?
 - c. To what extent have impacts been realized locally, regionally, nationally, and/or internationally?
2. Identify opportunities for coordination, leverage, and avoidance of unnecessary duplication of effort or resources.
 - a. What major strengths or unique capabilities are supported by the Activities?
 - i. People (teams, PIs, students, post docs)
 - ii. Specialized equipment
 - iii. Research support facilities
 - iv. Connections to key stakeholders or resources
 - v. Other
 - b. What major challenges or gaps limit the impact of the Activities?
 - i. People (teams, PIs, students, post docs)
 - ii. Specialized equipment
 - iii. Research support facilities
 - iv. Connections to key stakeholders or resources
 - v. Other
 - c. To what degree do the Activities currently coordinate with each other?
 - i. Is the level of coordination appropriate?
 - ii. What mechanisms are used for coordination?
 - iii. What could be done (institutionally or system-level) to enhance coordination?
 - d. To what degree do the Activities overlap with each other?
 - i. What is basis of overlap (e.g., research area, resource allocation, student recruitment, etc)?

- ii. Is the level of overlap appropriate?
 - iii. Are there un-necessary redundancies?
 - iv. What could be done (institutionally or system-level) to minimize un-necessary redundancies?
- 3. What must be done, institutionally or at the system level, to maximize the impact North Carolina's coastal and marine science Activities?
 - a. In the next 5 years, what are the most significant opportunities that could be pursued by the Activities, either individually or collectively?
 - i. What key success factors are needed (financial resources, infrastructure, people, collaboration, etc.)?
 - ii. What barriers or gaps of knowledge would need to be overcome?

Appendix: Site Visit Agenda

UNC Marine Science Activities Review & Site Visits Master Schedule Sunday January 27 – February 1, 2013

Sunday, January 27

6:00 pm – Dinner in Wilmington, Overview/Welcome with Dr. Chris Brown, UNC GA

Venue:

Manna
123 Street
Wilmington, N.C 28401 Tel 910 763-5252
<http://mannaavenue.com/>

Attendees:

Dr. Christopher F. D'Elia
Louisiana State University

Dr. Jacqueline Dixon
University of South Florida

Dr. Steven Lohrenz
University of Massachusetts

Dr. Nancy Targett
University of Delaware

Dr. Rieko Yajima
AAAS, Washington, DC

**Center for Marine Science (CMS)
Marvin K. Moss Lane
Wilmington, NC**

Monday, January 28, 2013

- 8:15-8:30 a.m. Chancellor Miller, Provost Battles Welcome remarks
- 8:30-10:00 a.m. **Presenters** Chris Finelli, Lynn Leonard, Sue Kesios, Jack Hall
Academic I: Intro.
- Marine Quest, BS Oceanography, BS Marine Biology, applied learning,
undergraduate research and scholarship, future
- 10:00-11:30 a.m. **Presenters** Chris Finelli, Joan Willey, Mark Imperial
Academic II: MS
- Marine Science, MPA Coastal Ocean Policy, MS Marine Biology, PhD Marine
Biology, graduate research and scholarship, future
- 11:30-12:30p.m. **Presenters** Dan Baden, Jeff Wright, Becky Porterfield
MARBIONC:
- Marine biotechnology, millennium campus model, MBA Business of Marine
Biotechnology, future
- 12:30-1:30 p.m. LUNCH
- 1:30-2:30 p.m. **Presenters** Dan Baden, John Morrison
- CMS: core facilities, enabling activities, mariculture operations, marine
alliance, ship, future.
- 2:30-4:00 p.m. Western Carolina
- 4:00-5:00 p.m. Tour

Point of Contact:

Daniel G. Baden, Ph.D.
William R. Kenan Distinguished Professor of Marine Science, and
Director UNCW Center for Marine Science
5600 Marvin K. Moss Lane
Wilmington NC 28409

--Drive to Morehead City--

**Institute of Marine Sciences
3431 Arendell Street
Morehead City, NC 28557-3301**

Tuesday, January 29, 2013

8:00 a.m. MS Review Committee Arrive @ IMS

8:00 – 8:30 a.m. Greeting by IMS Director, Rick Luettich & brief IMS Tour

8:30 – 10:30 a.m. UNC IMS

10:40-12:40 p.m. UNC Department Marine Science

12:45- 1:30 p.m. Lunch

1:30 - 3:00 p.m. ECSU

3:10 - 5:10 p.m. NC Sea Grant

IMS Points of Contact

*Deanna Napier	Receptionist / Admin Assistant	252-726-6841 x120	mdgood@email.unc.edu
Melynie Conner	Admin Assistant	252-726-6841 x121	connorma@email.unc.edu
Jean Stack	Admin Lead	252-726-6841 x123	cstack@email.unc.edu
Rick Luettich	Director	252-726-6841 x137	rick_luettich@unc.edu

*In charge of logistics on 1/29/2013

Point of contact:

Rick Luettich
UNC Chapel Hill Institute of Marine Sciences
Mobile (252) 342-6437
rick_luettich@unc.edu

Center for Marine Sciences and Technology (CMAST)
303 College Circle
Morehead City, NC 28557

Wednesday, January 30

Location:

Center for Marine Sciences and Technology (CMAST)
303 College Circle
Morehead City, NC 28557
Tel. 252 222-6302

Program:

I. CMAST Review & Discussion (0830—1010)

A. Overview by Dr. David Eggleston (Professor & CMAST Director) (12 mins)

B. CMAST Faculty Roundtable introductions (18 mins)

(i) College of Veterinary Medicine (Drs. Craig Harms, Suzanne Kennedy-Stoskopf, Michael Stoskopf)

(ii) College of Agricultural & Life Sciences (Drs. Jeff Buckel, David Green, Pat McClellan-Green)

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

E. AAAS Review Team Discussion (closed) (20 mins)

II. Department of Marine, Earth and Atmospheric Sciences (MEAS) (1020-1150)

A. Overview by Dr. Walt Robinson (Professor & Department Head) (10 mins)

B. MEAS Faculty Presentations (20 mins)

(i) Dr. Roy He, Physical Oceanographer

(ii) Dr. Nicholas Meskhidze, Atmospheric Chemist

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

E. AAAS Review team Discussion (closed) (20 mins)

III. Lunch 1200-1300 (second floor foyer)

IV. NC State University (non-CMAST & non-MEAS) (1300-1440)

A. Overview by Dr. Dave DeMaster (Professor & Chair of Marine Science Faculty)
(10 mins)

B. NCSU Faculty Presentations (20 mins)
(i) Dr. Margery Overton, Civil Engineer
(ii) Dr. Joanne Burkholder, Marine Ecologist

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

V. Summary & Synthesis of NCSU Activities (1450-1600)

A. Overview by Dr. Terri Lomax (Vice Chancellor for Research, Innovation & Entrepreneurship) (15 mins)

B. QA with AAAS Review Team (25 mins)

C. AAAS Review team Discussion (closed) (20 mins)

Meeting Ends at 1600

Point of contact:

David B. Eggleston
Director, Center for Marine Sciences and Technology
North Carolina State University
303 College Circle
Morehead City, NC 28557
Mobile 919-632-1720
(252) 222-6301 (o)
eggleston@ncsu.edu

--Drive to Manteo--

**UNC Coastal Studies Institute (UNC CSI)
850 NC Highway 345, Wanchese, NC 27981**

January 31, 2013

Research Building Room 262

Room 250 reserved for panel discussion sessions

8:00	Arrival
8:15 - 8:30	Welcome UNC CSI Chair of Board of Directors, Michael Kelly
8:30 – 10:00	UNC CSI First session (1.5 hrs)
10:00 - 11:15	Break and Tour of UNC CSI Facilities
11:15 -12:45	UNC CSI Second session (1.5 hrs) Three hours total as prescribed in the advisory
12:45 – 1:15	Lunch
1:15 - 3:15	ECU Block 1 (2 hrs) Ditto
3:15 - 3:30	Break
3:30 – 5:30	ECU Block 2 (2 hrs) Ditto
5:30 - 6:00	Break and Conference Time for Panelists

Point of contact:

Nancy White, UNC CSI Executive Director

Direct Line: 252-475-5408

Cell: 252-414-7757

**UNC Coastal Studies Institute (UNC CSI)
850 NC Highway 345, Wanchese, NC 27981**

February 1, 2013

Research Building Room 262
Room 250 reserved for panel discussion sessions

8:00 a.m. Panel Meeting

11:00 a.m. Lunch

12-noon Departure

Point of contact:

Nancy White, UNC CSI Executive Director

Direct Line: 252-475-5408

Cell: 252-414-7757